THE TREATMENT OF FRACTURE OF PATELLA.[1]

WITH REPORT OF RESULTS AFTER ARTHROTOMY AND SUTURE.

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My purpose in the present paper is to record my own personal experience in seven cases, being the total number under my care during the past nine years, one of which was treated by the non-operative plan by a posterior splint and strapping; the other six by the direct open method with wiring of the fragments.

The operative treatment of this condition has an historical value quite apart from the benefits which may follow it. In pre-antiseptic days any attempt at an operative treatment of fracture of the patella, which included opening the joint, had been followed in the majority of cases by disastrous destruction of the joint, even to amputation of the thigh, and death from pyæmia. Lord Lister endeavored to impress the truth of his opinions in regard to the antiseptic treatment of wounds by operating upon a series of fractures of the patella by the open method, and demonstrated by the success of his cases that it was possible to perform this operation with comparative safety.

He was not, however, the first to perform the operation according to his own method; Dr. Hector Cameron, of Glasgow, a former house surgeon of Lord Lister, did so on March 5, 1877, leaving the ends of the wire projecting through the wound, and drainage into the joint. Although bony union was not obtained, the parts were closely approximated, and the patient recovered with a useful limb.

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[1] Read at stated meeting of the Montreal Medico-Chirurgical Society, April 1, 1904.

Lord Lister's first case was in October of the same year, the details of the operation being the same as in Dr. Cameron's case. His second case was two years later.

On October 29, 1883, Lord Lister[1] delivered before the Medical Society of London an address on his experience to that date, which included seven cases, six of which he was able to bring before the Society. At this time he claimed that these cases demonstrated the success of his method and its easy accomplishment, providing no disaster occurs. Before commencing his first operation, he remarked to those about him that "No man was justified in performing this operation unless he could say with a clear conscience that he considered himself morally certain to avoid the entrance of any septic mischief into the wound."

Fracture of the patella may be divided into three classes, as follows: First. Indirect, or those due to muscular violence, a tear. Second. Direct violence, a blow. Third. A combination of the two, a tear and blow.

When this fracture occurs by muscular contraction the knee-joint is usually slightly flexed, bringing the articular surface of the patella, at about its centre, in contact with the head of the femur, producing a transverse fracture, dividing the patella into two fragments, the upper one most frequently the larger of the two. After the bone fractures, strong muscular contraction continues, producing a wide lateral tear in the aponeurosis.

Again, the fracture may be by direct violence, from the patient falling, the patella coming in contact with some hard substance, producing an irregular fracture, usually stellate, this involving the lower third of the bone. In this class of injury the damage to the aponeurosis may be very slight, occasionally an irregular laceration with one or more independently punctured wounds is seen. There is frequently no lateral laceration. Sometimes there is a combination of these two conditions, as in Case III of my series.

This third form occurs, first, by muscular contraction, the pain and loss of function permitting the patient to then fall to the ground, producing the above-mentioned condition; that is, there is a transverse fracture; a wide laceration of the aponeurosis; and one or more independent irregular tears involving the lower and anterior aspects of the aponeurosis.

This latter condition must be reckoned with in any operative measure to be considered, on account of the severe contusion to the soft parts, producing more or less hæmorrhage and resulting blood-clot, and greater interference with the blood supply, the whole tending to produce necrosis of the soft parts.

In the first class there are two points of importance: First. The wide laceration of the aponeurosis involving the lateral aspects, permitting wide separation of the fragments. This laceration usually occurs at a point below and parallel to the fracture, permitting the upper free portion to fall into the joint cavity between the fracture surfaces. This has been especially pointed out by Macewen[2] [3] and more recently by König.[4]

Second. Tilting forward of the fragments so that the fracture surfaces point away from the cavity. The displacement of the upper fragment is due to muscular contraction drawing more on the anterior than the lateral aspects, and in the lower fragment it is probably due to loss of support, permitting the fragment to fall downward, and possibly also from pressure of blood-clot and serum within the cavity. In several of my cases the large amount of blood-clot seemed a sufficient explanation in itself for the tilting forward of the lower fragment. In the second class there is usually little or no separation of the fragments owing to the absence of the transverse laceration, but there is, as above mentioned, much more contusion to the soft parts in the vicinity. In addition to the subcutaneous injury from contusion, the surface with which the patient comes in contact in his fall may produce serious injury to the skin, including wounds leading down to the injured bone, converting the injury into a compound or complicated wound. In the third class the combination of conditions is of importance, as, bearing on the future treatment, the contused condition of the lower part of the aponeurosis and the numerous hæmorrhages are an additional element of danger should the open method of treatment be followed. The normal blood supply to the patella is limited, and in fracture, particularly where the lateral aspects are involved, this is much interfered with, and has been thought to play some part in the difficulty in obtaining bony union. In all cases there is more or less acute synovitis accompanied by effusion.

The treatment is divided into non-operative and operative, and this latter further divided into early and late cases. If a non-operative treatment is followed, we must expect that a complete return of function cannot be obtained. There is always inability to completely control the movements of the limb. The patient is unable in many cases to undergo the fatigue of long walking or climbing, and in most cases there is an inability to control the limb in walking down hill, and particularly in walking down stairs. Although there may be close approximation of the fragments at first, there is a tendency to continued separation, and during the middle adult years while the patient may notice little difference in the affected limb in carrying out the ordinary daily duties, as age creeps on and muscular tone lessens, the muscular control diminishes; exercise produces fatigue, and in a moment of emergency the limb will not respond, thereby permitting a fall which may be the cause of serious injury to other parts of the body. On the other hand, if operative interference is permitted, it can only be carried out in chosen cases, especially those cases where there is transverse fracture with wide laceration of the aponeurosis.

The operation is called for more particularly in cases of the first and third classes of those above mentioned. It should be recommended only in persons under fifty years of age, in good general health, who are free from alcoholic taint, and not the subjects of constitutional or organic disease.

Occupation should also be considered. Persons who lead a sedentary life suffer less from the disability resulting from the non-operative treatment than those engaged in active work. A practical clinical feature demonstrating the necessity for operation is the ability of the patient to extend the leg. (There was total inability to extend the leg in all my cases.) Mikulicz[5] refers to this as a guide, at the same time pointing out that pain may prevent movement where the quadriceps is still intact. He operates in classes one and three, but not in class two unless there is some exceptional reason. He practises the transverse incision, using the brass wire instead of the silver as formerly, on account of its great strength.

Powers[6] contributes an exhaustive article, in which he records the opinions of seventy-one surgeons, a summary of which shows that four would use Malgaigne's method, seventeen are opposed to operation, nine would operate unless there were distinct contrary complications, forty-one would operate in selected cases, such as wide separation and comminution.

In more recent literature I think the tendency is to operate more frequently.

Of the non-operative measures: Approximating of the fractured bone by strapping and a posterior splint has been long practised, and apparently meets the indications in certain cases. Malgaigne's hooks and its various modifications are not now in as much favor as formerly, although they are still used to some extent in France. The method of Tilanus, introduced in 1885, sometimes called the "Dutch method," consists of the following (I quote from Powers[6]): "During the first twenty-four or forty-eight hours the limb is elevated and the joint compressed by an elastic bandage. On the second or third day massage is commenced. The upper fragment is fixed by the fingers of one hand, while with the other gentle pressure is made from the knee along the thigh muscles. Massage is carried out for from eight to fifteen minutes twice daily. In the interval the fragments are held in position by straps of plaster, and the limb is so elevated that the extensors of the thigh are relaxed and the return of function favored.

Passive motion is begun early. The patient should be up and about on crutches by the eighth or tenth day."

Of the operative methods: The objection to the so-called subcutaneous method is that at best the parts are only brought into apposition and held there, and there is the same uncertainty as to the final result as in any of the non-operative methods. In addition, there is the danger of infection through the cutaneous wound. Of these the method of subcutaneous suture of the aponeurosis above and below the patella was originally practised by Butcher.[7]

Barker's operation[8] consists in passing a heavy silver wire completely around the fractured bone from before backward through small incisions in front of the joint. The wire is passed round by means of a special needle suggested by Mr. Barker, and the suture left permanently in. Of Barker's operation I have no personal knowledge, but the wonderful success which the author has obtained commands our respect.

In Kocher's operation the wire is temporarily passed behind the fractured surfaces and tied on a pad, where it is left for from two to three weeks and then withdrawn.

The objections which have been offered to both are that a full view of the parts is not obtained; that the fracture surfaces are not inspected; that the blood-clot is not removed from the joint; that the torn aponeurosis is not removed from the fractured edges; that a foreign substance is left adjacent to the articular surfaces of the patella and passing through the front of the joint; and that the passing of the needle through the joint in introducing the wire is not without some danger.

Of the open method: There are four different incisions practised. First. The linear perpendicular incision about three inches long, having its centre opposite the fracture line. Second. The semilunar incision with convexity upward. Third. The semilunar incision with convexity downward. Fourth. The semilunar incision with convexity inward.

Of these the linear incision has now been superseded by the semilunar. Of these the second, in my opinion, is apt to interfere with the return of circulation and lead to some œdema, or even necrosis, of the flap. (This was seen in Case II). Of the third: I have followed this in my recent cases and have found it satisfactory. The objection that it is apt to leave a scar opposite the tuberosity of the tibia can be overcome by having the transverse portion of the incision above this point.

I have no experience of the fourth. It has been practised by my colleague, Dr. Armstrong, who considers that it lessens in a measure the interference with lateral circulation. This flap is lifted and the parts beneath are brought into view; the fracture surfaces cleansed of any intervening tissue and blood-clot, and brought together either by a single suture through drilled openings, or by two lateral sutures. These sutures may be of wire, silk, chromicized catgut, or kangaroo tendon.

The advantages of this open method are that it permits at once of a complete inspection of the field of operation; an accurate knowledge is obtained of the fracture or fractures in the bone, and the extent of the laceration of the aponeurosis. It permits of the free removal of blood-clot from the joint cavity, and of the approximation of the fractured surfaces, more particularly permitting one to see that the fracture surfaces are free from all intervening tissue. In considering the disadvantages, one must admit, in view of published statistics, that even in the hands of careful operators disastrous results have followed. These, however, may possibly be explained. In the first place, I think it must be admitted that the operation should never be performed except in the hands of fairly experienced operators who are surrounded by a technique with which they are familiar, and that it should only be done in selected cases, especially where there is bulging of the synovial sac at the end of a week or ten days' observation, during which period the limb has been elevated and appropriate local treatment carried out, such as an ice-bag applied to the knee. (This distention of the sac was present in all my cases.) When it is possible to recognize tilting forward of the fracture surfaces, and where there is separation of the fragments with inability to extend the leg. In late cases, where there is wide separation of the fragments and marked loss of function after a fair trial of the usual non-operative measures.

In my series I have met with all the above conditions, more particularly the laceration of the aponeurosis at a point below the fracture line in the bone, permitting a curtain-like band of thinned-out, shreddy tissue, in one case as much as two inches, to fall towards the centre of the joint and between the fracture surfaces. In each case that this was noted, this fringe was closely adherent to the upper fragment intimately mixed with more or less organized blood-clot requiring active curetting of the fracture surfaces before the bone could be properly exposed. The amount of blood-clot found within the joint, even in late cases, was also somewhat of a surprise to me. The claim that this can be removed by aspiration or by a trochar I am not able to concur in. How much of it would be ultimately absorbed it is impossible to say. It is fair to assume, however, that portions of it become organized and play an important part in the development of adhesions, and it is admitted that it is a danger in recent cases should infection be threatened. I have found firm, hard clots occupying the anterior part of the joint cavity and separating the fracture surfaces that were with difficulty removed. In dealing with the danger of infection: I think too much importance has been attached to this accident as applied to wiring the patella, and too little to the same accident as seen in other fields, notably in operations involving the peritoneum. It must be admitted that not infrequently, at the hands of skilled surgeons surrounded by well-tried operating-room technique, the accidental infection of the peritoneum in doing an interval appendectomy or an exploratory laparotomy is seen with fatal results. It is held that this infection may come from the air as well as from some fault in the technique. These accidents are unfortunate whenever they happen, but I question if it is fair to condemn one operation without condemning all. Without operation, although a fairly useful limb is obtained, it is never perfect; the individual is at a disadvantage throughout the rest of his life. In the case of workmen, men having to carry heavy weights, the loss of function is frequently progressive, often incapacitating the subject from following any of the ordinary laborious occupations; on the other hand, one is able to get such complete restoration of the function by operation that it is impossible for an ordinary observer to recognize any defect, as in Cases I, IV, and V. Bahr[9] reports that in an analysis of forty-four old cases, 35 per cent. showed complete disability so far as gaining a livelihood was concerned. On the other hand, in a favorable case which terminates satisfactorily, complete restoration of function of the limb is obtained; in some cases so perfect that the patient is unable to detect any difference, as in Case IV.

Regarding the time one should operate: My practice has been to allow the acute symptoms of synovitis and injury to the surrounding tissues to subside, this usually taking from a week to ten days. This, however, may be an unnecessary precaution, many preferring to operate as soon after the accident as possible, notably Watson Cheyne.[10]

After-Treatment.—A light posterior splint for a week or two, after which time the patient should be up and about, using crutches or a stick. At the end of four weeks all dressings should be removed, except a light protective bandage. Massage and passive movement should be carried out after the removal of cutaneous sutures, that is, after ten days. If the wire suture should cause any superficial irritation, it may be removed after six weeks by a small incision with the aid of local anæsthesia. (In none of my cases has this been necessary, although I may have to do it in Case VI.)

In my series the following points of technique were particularly observed:

The operation was done quickly. Rubber gloves were used. As soon as the joint was opened, sterilized gauze saturated in normal salt solution was carefully packed into the cavity. Continuous irrigation with salt solution was kept up. The only foreign substance, other than the gauze, introduced at any time during the operation was a forceps, or curette, to lift out blood-clot. Special care was taken in adjusting the torn aponeurosis, particularly in getting careful apposition on the lateral aspects. The postoperative treatment included elevation of the whole limb. Early massage and passive movement.

I append an analytical digest of the histories of the seven cases which form the basis of the present communication.

CASE I.—M. C.; male, twenty-four years; plumber. *Date of Injury.*—June 4, 1895. *Nature of Violence.*—Direct. *Diagnosis.*—Transverse fracture, separation of one-half inch. Marked synovitis. *Operation; Days after Injury.*—Fifty-six days. Delayed a few days owing to pustular dermatitis due to blister plaster having been applied before coming under our notice. *Incision.*—Median linear. *Condition found.*—Of bone: Stellate fracture upper fragment, two-thirds of whole, fracture surface of lower facing forward. Of soft tissues: Large transverse rupture of aponeurosis, mass of fibrous tissue between fragments. *Suture Material.*—Silver wire at first introduced but broke, and was finally replaced by five strands of silkworm gut through one centrally drilled opening. *Approximation of Fragments.*—Impossible until a silk suture was passed through aponeurosis above and below patella and tied. *Postoperative Treatment.*—Plaster of Paris for six weeks. *Result at Present Date.*—Complete restoration of function; has been regularly at work since three months subsequent to operation. Recent radiograph shows perfect bony union. (Fig. 1.)

CASE II.—H. R.; male; twenty-nine years; delivery driver. *Date of Injury.*—November 20, 1902. *Nature of Violence.*—Indirect and direct (fell on knee after he heard and felt the break). *Diagnosis.*—Transverse fracture, low down; marked synovitis; severe injury to superficial soft tissues. *Operation; Days after Injury.*—Eleven days. *Incision.*—Semilunar, convexity upward. *Condition found.*—Of bone: Transverse fracture upper fragment three-fourths of whole, fracture surface of both fragments facing forward. Of soft tissues: Large oblique rent extending from a point about two inches below fracture line on inner side to edge of fracture on outer side. Fringes of this, two inches long, hanging over fracture surface of upper fragment. *Suture Material.*—

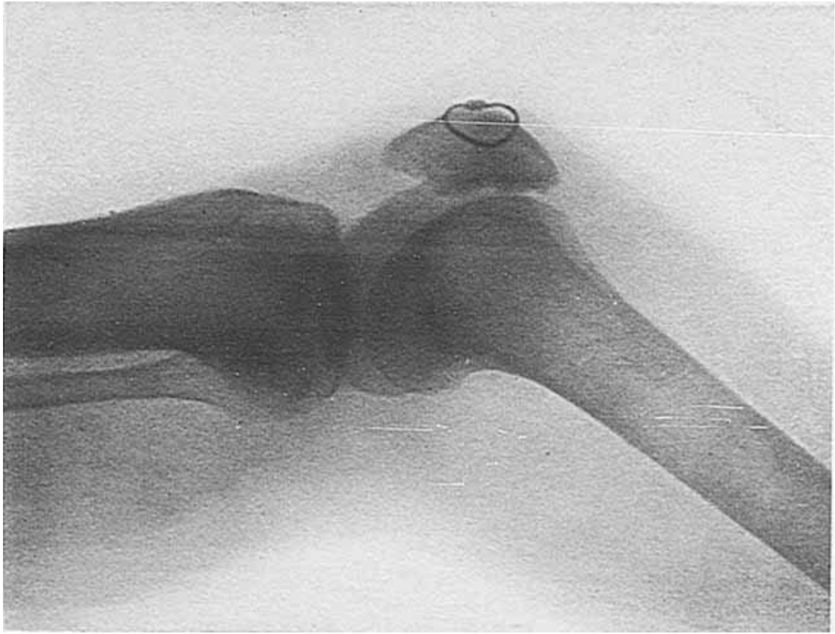

FIG. 5.—Final result after suture of fractured patella (Case IV).

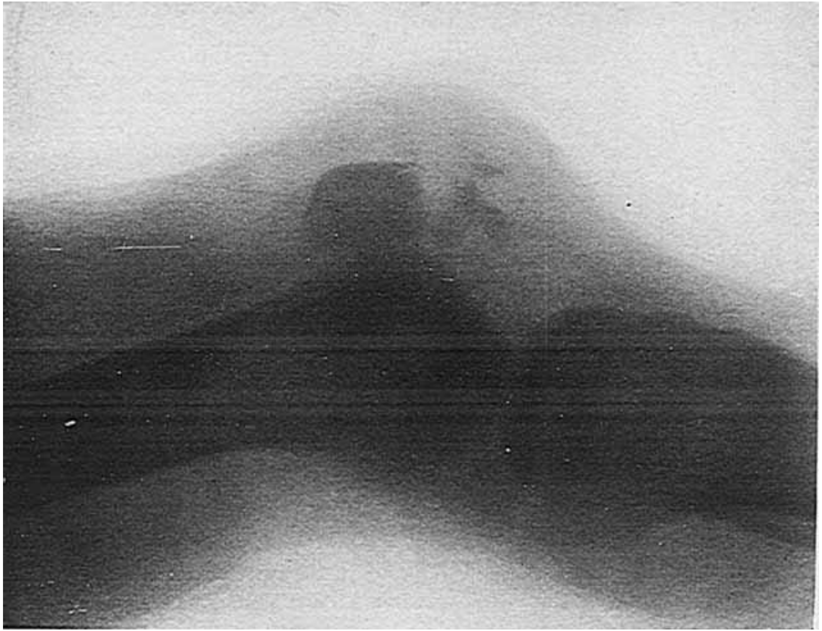

FIG. 6.—Comminuted fracture of patella (Case V).

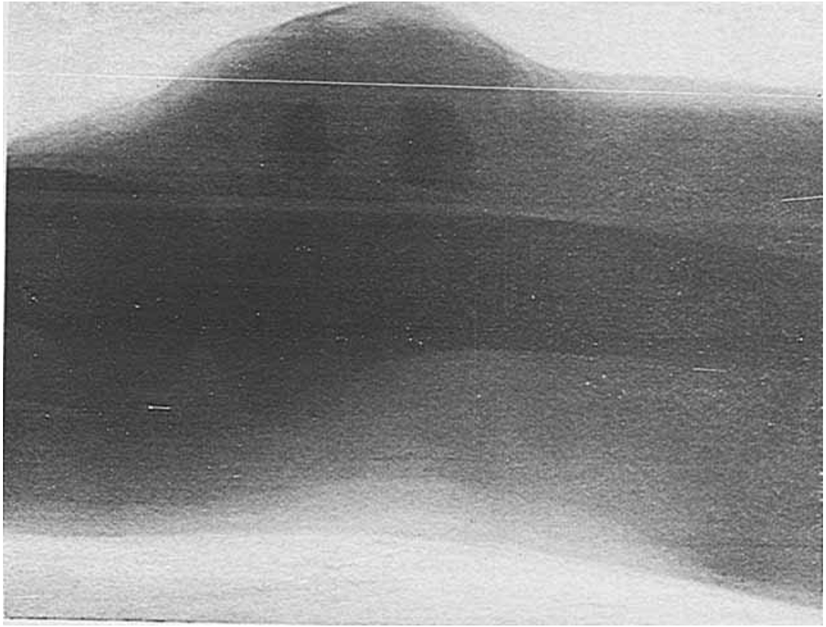

FIG. 7.—Fracture of patella; condition before arthrotomy and suture (Case VI).

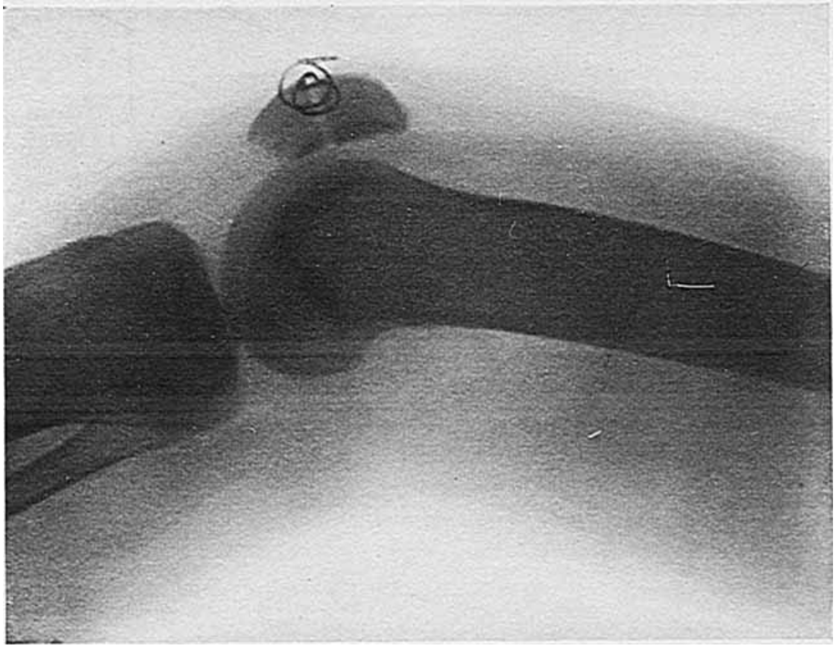

FIG. 8.—Fracture of patella; condition after suture (Case VI).

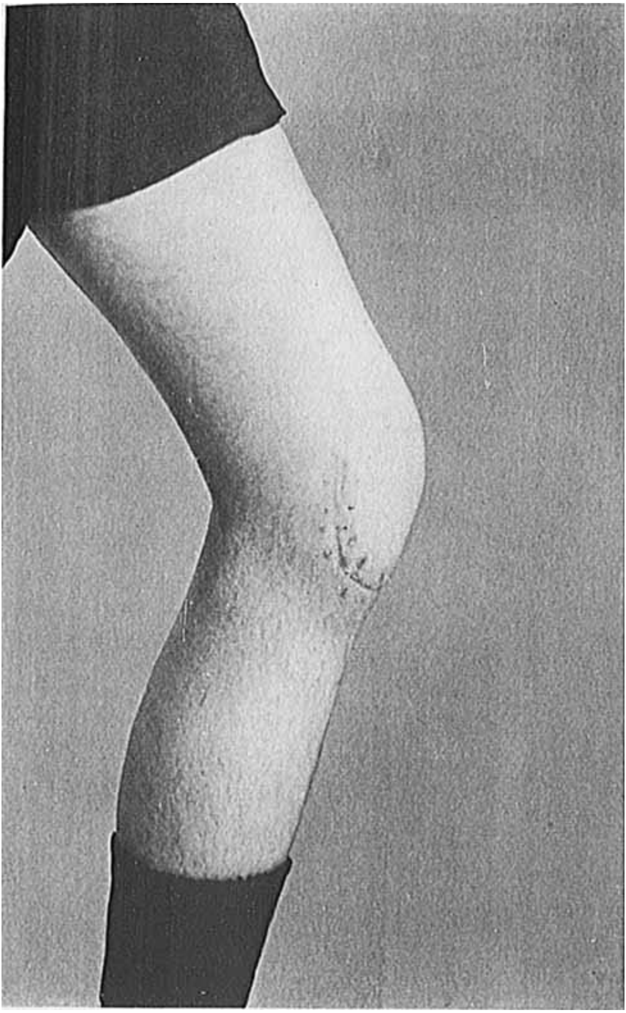

FIG. 9.—Showing skin cicatrix in Case VI twenty-eight days after operation.

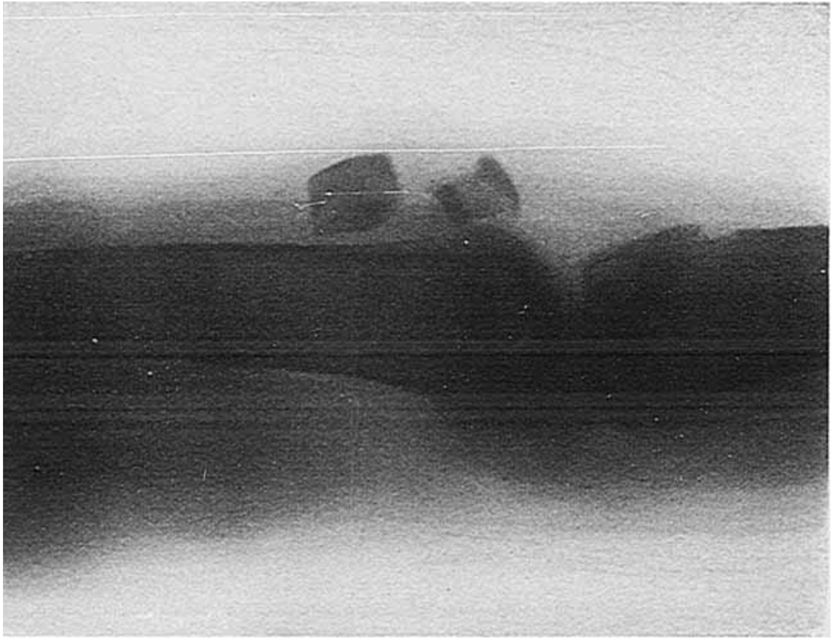

FIG. 10.—Fracture of patella, recent; treated by non-operative measures (Case VII).

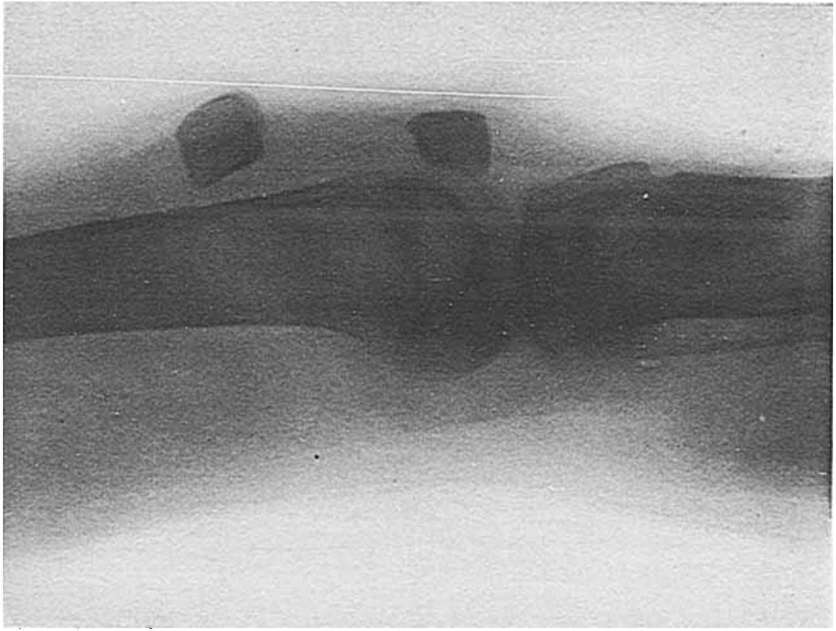

FIG. 11.—Ultimate result in Case VII, treated by non-operative measures; limb extended.

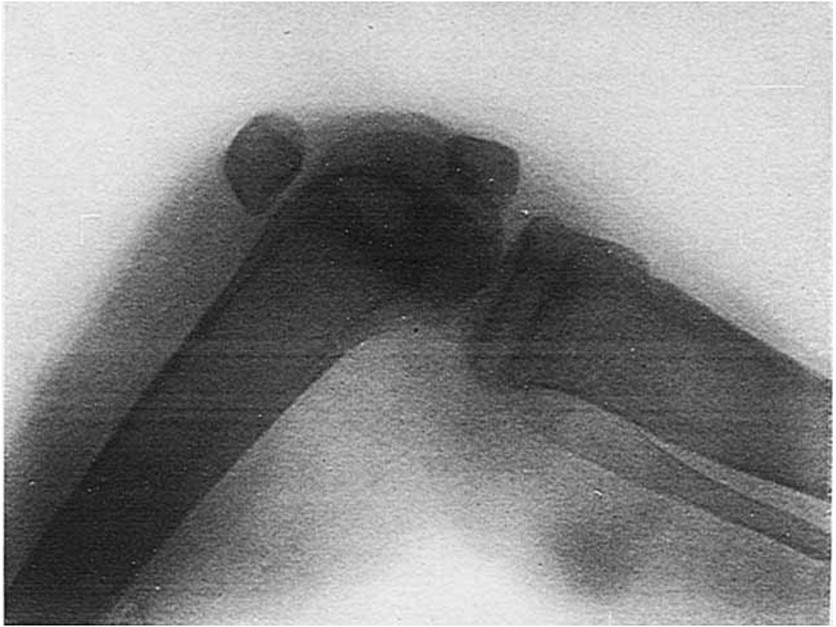

FIG. 12.—Ultimate result in Case VII, treated by non-operative measures; *limb flexed.*

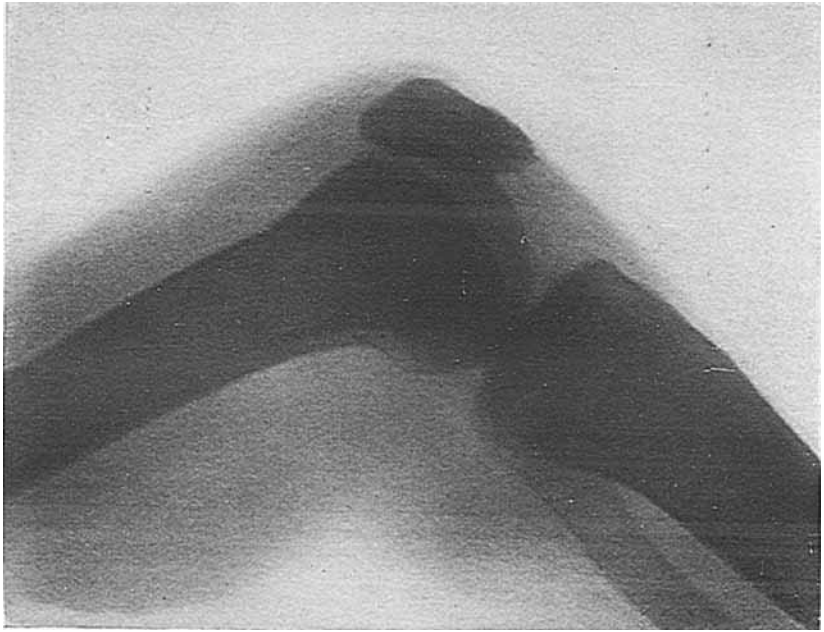

FIG. 1.—Radiograph showing result of suture of fractured patella (Case I).

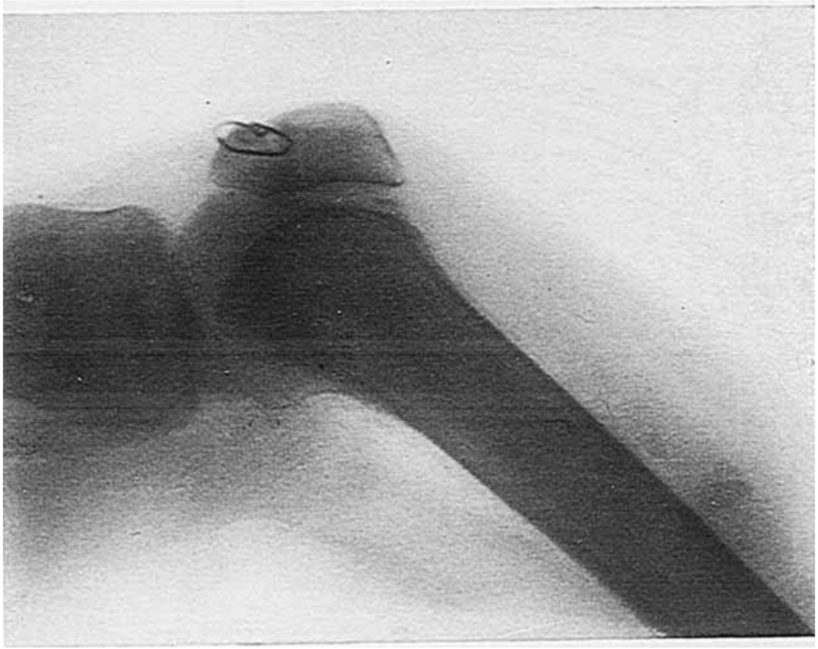

FIG. 2.—Result of patella suture (Case *II*).

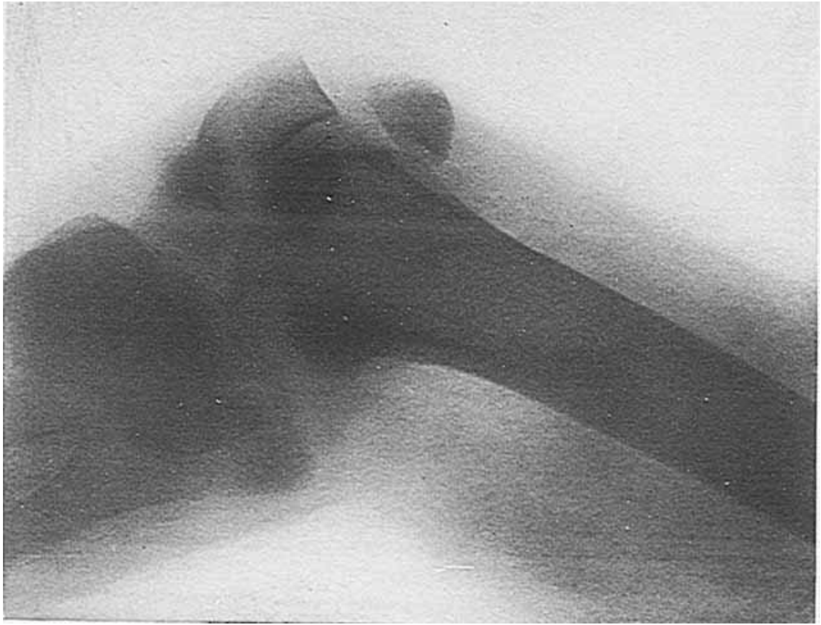

FIG. 3.—Fracture of patella; condition before suture (Case III).

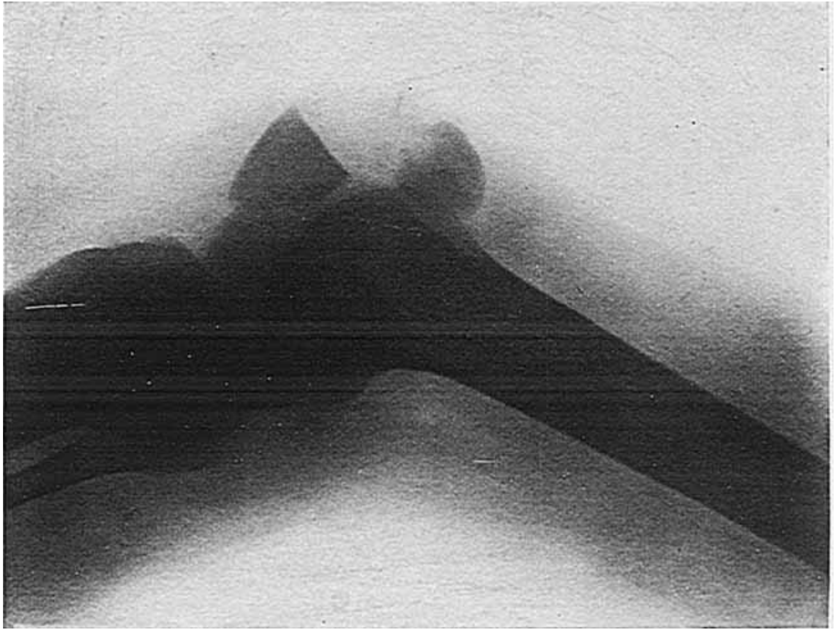

FIG. 4.—Fracture of patella; condition before suture (Case IV).

Single silver wire through centrally drilled openings. *Approximation of Fragments.*—Easily brought together. *Postoperative Treatment.*—Plaster of Paris for about six weeks. *Result at Present Date.*—Superficial suppuration from original damage of soft parts, synovitis present for some weeks. Some months later, while adhesions were being broken down under ether, patella again fractured, partly through old fracture line and partly below. Posterior splint and straps at once applied for six weeks. Good union without separation. Patella freely movable; movement of joint is now normal; has been driving laundry delivery regularly and with comfort. Recent radiograph shows that bony union is not complete, a small fissure being present close to the anterior aspect; this is probably due to the second fracture. (Fig. 2.)

CASE III.—J. McN.; male; thirty-three years; laborer. *Date of Injury.*—August 24, 1902. *Nature of Violence.*—Probably direct. *Diagnosis.*—Transverse fracture, treated with strapping and posterior splint; unable to walk at end of four months; separation of three-fourths of an inch. *Operation; Days after Injury.*—One hundred and twenty-nine days. *Incision.*—Semilunar incision, convexity downward. *Condition found.*—Of bone: Transverse, two-thirds in upper fragment, lower fragment facing forward. (Fig. 3.) Of soft tissues: Thin fibrous band connected separated fragments. *Suture Material.*—Silver wire through two laterally drilled openings. *Approximation of Fragments.*—Easily brought together. *Postoperative Treatment.*—Plaster of Paris for five weeks. *Result at Present Date.*—Man has been regularly at work and reported that he was perfectly well. Have been unable to get recent radiograph.

CASE IV.—F. L.; male; fifty years; carpenter. *Date of Injury.*—December 19, 1902. *Nature of Violence.*—Direct. *Diagnosis.*—Transverse fracture. *Operation; Days after Injury.*—Sixteen days. *Incision.*—Semilunar incision, convexity downward. *Condition found.*—Of bone: Transverse one-third in upper fragment, both fracture surfaces facing forward. (Fig. 4.) Of soft tissues: Aponeurosis torn below line of fracture; upper portion lying between fragments in numerous bands and threads. *Suture Material.*—Silver wire through one centrally drilled opening. *Approximation of Fragments.*—Easily brought together. *Postoperative Treatment.*—Plaster of Paris about three weeks. Massage and passive movement at end of third week. *Result at*

Present Date.—Complete restoration of function. Radiograph shows bony union. (Fig. 5.)

CASE V.—T. L.; male; forty-one years; stonemason. *Date of Injury.*—November 22, 1903. *Nature of Violence.*—Direct. *Diagnosis.*—Well-marked transverse fracture, synovitis. *Operation; Days after Injury.*—Eight days. *Incision.*—Semilunar incision, convexity downward. *Condition found.*—Of bone: Transverse, with comminution of lower fragment, three-fourths in upper fragment. (Fig. 6.) Of soft tissues: Aponeurosis torn below line of fracture, upper portion lying between fragments in numerous bands and threads. Large blood-clots in joint cavity. *Suture Material.*—Chromic catgut suture through laterally drilled openings in upper fragment; passed between comminuted lower fragments out through the patellar ligament; reintroduced and passed between the bone and aponeurosis on extreme lateral aspects and out through aponeurosis to a point close to top of opening in upper fragment and tied. *Approximation of Fragments.*—Easily brought together. *Postoperative Treatment.*—Posterior splint and elevation of thigh for a few days. Early massage and passive movement. *Result at Present Date.*—Gradual return of function; patella freely movable; no pain. Have been unable to get recent radiograph.

CASE VI.—E. C.; male; twenty-two years; laborer. *Date of Injury.*—December 29, 1903. *Nature of Violence.*—Indirect. *Diagnosis.*—Transverse fracture; marked synovitis; separation three-fourths of an inch. *Operation; Days after Injury.*—Thirteen days. *Incision.*—Semilunar incision, convexity downward. *Condition found.*—Of bone: Transverse fracture. (Fig. 7.) Of soft tissues: Aponeurosis torn below line of fracture, upper portion lying between fragments in numerous bands and threads. Large blood-clot in cavity. *Suture Material.*—Silver wire through two laterally drilled openings. *Approximation of Fragments.*—Easily brought together. *Postoperative Treatment.*—Posterior splint and elevation of thigh for a few days, followed by early massage and passive movement. *Result at Present Date.*—Walked without assistance or support in two weeks; complete return of function. Recent radiograph (Fig. 8) shows shadow produced by new bone.

CASE VII.—J. B.; male; thirty-two years; beer-bottler. *Date of Injury.*—October 10, 1902. *Nature of Violence.*—Indirect. *Diagnosis.*—Transverse fracture; slight separation; marked synovitis; eversion forward of lower fragment; crepitus easily elicited. *Treatment.*—Strapping, posterior splint, elevation of leg, massage. *Result at Present Date.*—Separation of fragments in repose about two and a half inches (Figs. 11 and 12), function good. Walks with some lameness, and is unable to control limb in stepping down from an elevation, as in walking down stairs.

Of the six cases operated upon all walked without lameness, and are able to go up and down stairs without any noticeable difficulty. The one case that showed lameness, namely, that unoperated upon, was unable to step down from a chair, although he has what is called a good result.

My thanks are due to Mr. W. P. Watson, director of the X-ray laboratory of the Montreal General Hospital, for the excellent radiographs he has supplied.

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